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Preoperative GERD is Associated with Increased Morbidity in Patients Undergoing Abdominal Surgery

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Abstract

Background: In North America, the prevalence of gastro-esophageal reflux disorder ranges from 18.1% to 27.8%. We measured the risk posed by preoperative esophageal disease for patients undergoing abdominal operations.

Method: 2005–2015 ACS NSQIP data were merged with institutional Clinical Data Repository records to identify esophageal disease in surgical patients undergoing intra-abdominal procedures. Patients with esophageal disease were classified as gastro-esophageal reflux (GERD) or Other, which included patients with esophageal stricture, spasm, ulcer, or diverticuli, achalasia, esophagitis, reflux esophagitis, Barrett's esophagus, and multiple esophageal diagnoses, excluding GERD. ACS NSQIP targeted procedures groups included were colectomy, proctectomy, ventral hernia repair, bariatric surgery, hepatectomy, appendectomy, abdominal aortic aneurysm repair, open aortoiliac repair, hysterectomy, myomectomy, and oophorectomy. Multivariable logistic regression was used to model postoperative complication rates, adjusting for ACS NSQIP risk of morbidity, demographic factors, ACS NSQIP targeted procedure groups, and open versus laparoscopic surgery.

Results: Of 9,172 intra-abdominal cases, 21.3% had preoperative esophageal disease (19.6% GERD and 1.7% Other). After adjustment, patients with GERD were at higher risk for experiencing a number of complications, including all-cause 30-day complication (OR= 1.21, 95% CI 1.05–1.41, $p = 0.044$), renal complication (OR= 1.43, 95% CI 1.09–1.87, $p = 0.036$), wound complication (OR= 1.40, 95% CI 1.10 – 1.79, $p = 0.028$), and readmission within 30 days (OR= 1.66, 95% CI 1.35–2.04, $p < 0.001$).

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Disclosure

The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article.

Conclusion: Preoperative GERD is associated with increased postoperative complication rate. Surgeons should consider assessing GERD in patients undergoing abdominal operations.

Keywords

GERD; Esophageal Disease; Abdominal Surgery; Postoperative complications

Introduction

Estimates of gastro-esophageal reflux disorder (GERD) prevalence in North America range from 18.1% to 27.8% (1), and the prevalence of all esophageal disease, while not reliably measured, is higher. Esophageal disease, which includes GERD as well as less common diseases such as achalasia, is also present in a consistent subset of surgical patients. Despite its frequency in surgical patients, the preoperative presence of esophageal disease is not well quantified, in part due to its absence from widely available surgical databases such as the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP). Dysphagia, particularly when associated with esophageal disease, contributes to hospital-acquired pneumonia (2), and increases in-hospital length of stay (3). However, the impact of GERD on postoperative morbidity in surgical patients remains unclear. If preoperative esophageal disease correlates with postoperative complications, an opportunity exists to improve outcomes, as GERD is a highly treatable disease (4). Effective treatment includes lifestyle changes such as weight loss and modification of dietary habits (5) as well as medications such as H2 blockers and proton pump inhibitors (6). This study sought to determine whether there is an association between esophageal disease and postoperative complication rate in surgical patients.

In patients undergoing bariatric surgery, preoperative GERD is associated with higher reoperation rates (7, 8) higher readmission rates (9), and higher instance of overall postoperative complications, especially adverse gastrointestinal events (7). In patients undergoing lap-band procedure, presence of a hiatal hernia or esophageal dysmotility disorder was associated with an increased reoperation rate and presence of both pathologies further increased the risk of reoperation (10). Measures of preoperative esophageal disease such as abnormal manometry scores (11) and pH monitoring (12) predict higher instances of postoperative complications and are associated with severe postoperative emesis and food intolerance, respectively. However, little data exists on the impact of preoperative esophageal disease on morbidity in patients undergoing other types of abdominal surgeries, as well as the adverse impact of medically diagnosed esophageal disease other than GERD. We chose to explore intra-abdominal procedures to both expand the scope of available data and relate our results to currently published data on bariatric surgery.

The purpose of this study is to assess the association of pre-existing esophageal disease and GERD specifically as a risk factor for all-cause morbidity in patients either undergoing surgery involving the gastrointestinal tract or undergoing a procedure requiring an intra-abdominal approach. We hypothesized that preoperative esophageal disease increases all-cause morbidity, particularly in this subset of patients.

Methods

A retrospective review was conducted merging two prospectively collected databases: ACS NSQIP and the institutional Clinical Data Repository (CDR). Institutional Review Board approval (UVA IRB#18808) for this study was obtained prior to data acquisition. No informed consent was obtained for this review. The institutional CDR was used to identify patients with International Classification of Diseases, Ninth Revision, Clinical Modification (ICD9) codes corresponding to benign esophageal diseases of interest: 530.0 (achalasia), 530.1 (esophagitis), 530.11 (reflux esophagitis), 530.12 (acute esophagitis), 530.2 (esophageal ulcer), 530.3 (esophageal stricture), 530.5 (esophageal dyskinesia), 530.6 (esophageal diverticulum), 530.81 (esophageal reflux/GERD), and 530.85 (Barrett's esophagus). Patients with an esophageal malignancy, a pre-existing complication diagnosed prior to surgery such as sepsis or ventilator dependence, and patients less than 18 years of age at the time of surgery were excluded from analysis.

Within the ACS NSQIP data, patients undergoing operations via an intra-abdominal approach were identified and aggregated using the ACS NSQIP 2015 CPT targeted procedures group codes (Appendix 1). The subset of targeted procedure groups included for analysis were colectomy, proctectomy, ventral hernia repair, bariatric surgery, hepatectomy, appendectomy, abdominal aortic aneurysm repair, open aortoiliac repair, hysterectomy, myomectomy, and oophorectomy. Hysterectomy, myomectomy, and oophorectomy were combined for the purposes of analysis. Patients with esophageal disease documented on the day of discharge following their surgical procedure or prior to admission were classified as having preoperative esophageal disease. Preoperative esophageal disease was defined in this way to identify patients with an esophageal disease diagnosis documented elsewhere but not entered into our institution's electronic medical record until discharge reconciliation. The esophageal disease status in patients undergoing multiple surgeries was determined based on the date of esophageal disease diagnosis and discharge date per surgical hospitalization. Thus, classification of esophageal status was determined separately for each clinical encounter and can vary even for the same patient for multiple encounters. ACS NSQIP data from January 1, 2005- December 31, 2014 was linked to institutional Clinical Data Repository for the corresponding study years. The primary outcome of interest was 30-day all-cause morbidity. Secondary outcomes assessed included 30-day hospital readmissions and unplanned reoperations.

GERD can be associated with respiratory pathologies such as asthma (13) as well as with intra- and post-operative aspiration in the setting of lung transplant (14, 15). Atrial fibrillation (16) and acute myocardial infarction (17) have also been linked to GERD. Kidney injury, both acute (18) and chronic (19), while not directly associated with GERD have been associated with proton pump inhibitor use. To identify specific types of complications associated with esophageal disease, we conducted a subgroup analysis in which we further subdivided all-cause morbidity into five types of complications: wound complications (including wound disruption, superficial, deep, and organ space infections); respiratory complications (pneumonia, unplanned intubation, ventilator support for longer than 48 hours, and pulmonary embolus); renal complications (urinary tract infection, acute renal failure and progressive renal insufficiency); cardiovascular complications (myocardial

infarction, cardiac arrest, and cerebrovascular accident); and other complications (transfusion of greater than 4 units of packed red blood cells within 72 hours after surgery, graft failure, deep venous thrombosis, sepsis, and septic shock).

Statistical Analysis

Patients were divided into the following mutually exclusive categories: GERD (patients with GERD or GERD plus another esophageal disease), Other (patients with any other previously described esophageal diagnoses, excluding GERD), and no esophageal disease. A combined endpoint of any complication as well as subgroup analysis by complication type, readmission, and reoperation were modeled as a function of preoperative esophageal disease category using bivariate analysis and multivariate logistic regression. These p values were Bonferroni corrected for multiple comparisons. Our post-hoc power analysis shows that our sample is not adequately powered to detect differences in respiratory and cardiovascular complication rates between esophageal disease groups and these associations were not developed further.

A sensitivity analysis was performed to confirm our hypothesis that patients with both GERD and another esophageal disease had risk profiles similar to patients with GERD compared to patients with other esophageal disease diagnoses. This was accomplished by subdividing the GERD group, as listed above, into: GERD Only (patients with GERD without another esophageal disease), and Both (patients with both GERD and another esophageal diagnosis). For this sensitivity analysis, we estimated separate multivariable logistic regression for all-cause 30-day morbidity, each complication type, as well as readmission and reoperation rates, as a function of the newly defined esophageal group.

We assessed the prevalence of obesity in patients undergoing surgery other than bariatric surgery with and without GERD. We assessed the impact of obesity on all-cause complication rate in patients undergoing surgery other than bariatric surgery as well as all patients in our study sample including bariatric surgery. As part of a sensitivity analysis, we included obesity as a covariate to determine whether obesity would impact the effect of GERD on complication rate. As part of the same sensitivity analysis, we assessed the impact of GERD on complication rate excluding obese patients.

All models were adjusted for ACS NSQIP risk score for morbidity (20), demographic factors including age, sex, race/ethnicity, specific ACS NSQIP targeted procedure groups, and an open versus laparoscopic surgery indicator. Statistical analysis was performed using Stata SE v14 (StataCorp, College Station, TX).

Results

Between January 2005 and December 2014, the total number of ACS NSQIP cases, merged with institutional CDR was 22,098. Of these, 9,175 satisfied the inclusion criteria with primary operative CPT codes within one of the targeted abdominal ACS NSQIP procedure groups. An additional three cases were excluded due to incomplete data for a total 9,172 cases included for comparative analyses and multivariate modeling.

Overall, mean age was 53.73 (SD 15.93). In our cohort, 41.8% were male and 82.8% Caucasian. Esophageal disease was present in 21.3% of included patients; 19.6 % of patients had GERD, and 1.7 % of patients had other esophageal disease. Patients with GERD and other esophageal disease were on average 1.3 years and 6.3 years, respectively, older than patients with no esophageal disease ($p < 0.001$). A higher proportion of patients with GERD underwent laparoscopic procedures compared to patients with no disease or other esophageal disease ($p < 0.001$). Table 1 shows patient demographics stratified by disease category.

Of the targeted procedure groups, bariatric surgery had the highest proportion of patients with GERD, 33.2%, followed by ventral hernia repair, 29.7%, and open aortoiliac repair, 18.6%. Prevalence of esophageal disease in all targeted procedure groups is reported in Table 2. All-cause morbidity across all groups was 22.3%; postoperative wound complication rate was 5.0%, postoperative respiratory complication rate was 4.6%, postoperative renal complication rate was 4.1%, reoperation rate was 5.0%, and 30-day readmission rate was 6.2%.

The unadjusted all-cause 30-day postoperative complication rates for different esophageal disease groups were as follows: no disease, 22.5% (1,623/7,221); GERD, 21.1% (379/1,800); Other, 27.3% (42/154). There was no significant difference in complication rates. In all patients, laparoscopic procedures had fewer complications than open (OR = 0.53, $p < 0.001$). After adjusting for this, as well as age, sex, race, targeted procedure group, and ACS NSQIP morbidity risk score, we found that patients with GERD were 21% more likely than those with no esophageal disease to experience any complication (OR = 1.21, 95% CI 1.05 – 1.41, $p = 0.044$). We did not find an association between other esophageal disease and overall complication risk.

Results of the multivariate analysis by complication are shown in Figure 2. P values are corrected for these multiple comparisons. Of the complication subtypes, patients with GERD were more likely to experience wound complications (OR= 1.40, 95% CI 1.10 – 1.79, $p = 0.028$) as well as renal complications (OR = 1.43, 95% CI 1.09 – 1.87, $p = 0.036$) than patients with no esophageal disease. Post-hoc power analyses showed that the comparisons between GERD and no esophageal disease groups were not adequately powered for respiratory and cardiovascular complications. The minimal detectable odds ratio to find a difference between GERD and no disease was 3.1 for respiratory complications and 16.9 for cardiovascular complications.

Readmission rates were highest among patients with GERD. The unadjusted readmission rates for esophageal disease were 5.75% (415/7,221) for no disease, 5.84% (9/154) for other esophageal disease, and 8.22% (148/1800) for GERD ($p < 0.001$). In the adjusted multivariate model this remained significant and patients with GERD were found to be 66% more likely to require readmission within 30 days (OR = 1.66, 95% CI 1.35 – 2.04, $p < 0.001$). Reoperation rates did not differ significantly between esophageal disease categories; however, as above, we were unable to assess the risk accurately between groups due to low power. We did not find an association between other esophageal disease and readmission risk.

We conducted sensitivity analyses to determine the risk profile of patients with both GERD and another esophageal disease and the effect of overall complication rate, specific complication type rates, and readmission rate. After subdividing the 1,800 patients with GERD, 1,475 (16.1% of all patients) were classified as GERD Only and 325 (3.5% of all patients) were classified as Both. Patients with Both were, on average, 2.9 years younger than patients with other esophageal disease and 2.61 years older than GERD Only patients ($p < 0.001$). Male patients accounted for 28.9% in Both, compared to 34.4% in GERD Only and 50.7% in Other. A higher proportion of African American patients (21.2%) were Both compared to GERD Only (14.4%) and other esophageal disease (14.9%), $p < 0.001$. Patients with Both were similarly as likely to undergo laparoscopic surgery compared with GERD Only patients compared to Other esophageal disease patients, 44.6% versus 49.3% versus 29.9%, respectively, ($p < 0.001$).

The unadjusted all-cause 30-day postoperative complication rates were 21.2% (313/1475) for GERD Only, 27.3% (42/154) for Other, and 20.3% (66/325) for Both, with no significant difference. After adjustment for laparoscopic procedure indicator, as well as age, sex, race, targeted procedure group, and ACS NSQIP morbidity risk score, we found that patients with GERD Only were 20.9% more likely than those with no esophageal disease to experience any complication (OR = 1.21, 95% CI 1.03 – 1.41, $p = 0.019$). While not significantly different from patients with no esophageal disease, the odds ratio for patients with Both diseases was 1.22 (95% CI 0.90–1.67), compared to 1.14 (95% CI 0.77 – 1.70) for other esophageal disease. The unadjusted readmission rate was 8.3% (123/1,475) for GERD Only and 7.7% (25/325) for Both, higher than the 5.8% (9/154) for Other ($p = 0.002$). After adjustment, readmission rates for GERD Only (OR 1.68, 95% CI 1.35 – 2.09, $p < 0.001$) and Both (OR 1.57, 95% CI 1.02– 2.41, $p = 0.04$) were higher than for no esophageal disease.

We conducted additional sensitivity analyses to assess the impact of obesity on complication rate, as GERD and obesity are correlated (1). Excluding bariatric surgery, patients with GERD (43.8%) were more likely to be obese than patients with other (30.9%) or patients with no (34.4%) esophageal disease ($p < 0.001$). Excluding bariatric surgery, obesity was associated with a higher all-cause complication rate (OR = 1.22, 95% CI 1.07–1.38, $p = 0.003$). Adding obesity as a covariate in our multivariable analysis did not change the impact of GERD on all-cause morbidity (OR 1.21, 95% CI 1.04 – 1.40, $p = 0.013$). In a subset of non-obese patients the impact of GERD on all-cause morbidity approached significance (OR = 1.18, 95% CI 1.00–1.39), $p = 0.053$. Of note, the total number of patients decreased from 9,175 to 4,704 (or 48.8%), while the number of patients with GERD decreased from 1,800 to 667 (62.9%).

Discussion

In our institutional cohort, the prevalence of GERD was 19.62%, comparable to the measured GERD prevalence of between 18.1% and 27.8% in the general North American population (1). Patients with GERD were also more likely to be female, African American, and undergo a laparoscopic procedure. We found no difference in overall or subtype of complication rates by esophageal disease status in bivariate analysis given the differences found in patient characteristics at baseline. Once adjusted in the multivariate model, we

found that patients with GERD were 21% more likely to experience any complication compared to patients without any esophageal disease. In addition, we found that patients with GERD were 40% more likely to experience wound complication, and 43% more likely to experience renal complications compared to those without esophageal disease. Our findings show that patients with GERD were 66% more likely to be readmitted. This was consistent with Dorman et al.'s 2012 study of readmission rates following adjustable gastric banding, but suggests that the finding may be more widely representative across major abdominal procedures (9). Interestingly, we did not find any significant association between other esophageal disease and all-cause 30-day complication rate in bivariate or in multivariate analysis.

By splitting GERD patients into GERD Only and Both, we showed that patients with Both were more likely to be African American, female, and undergo a laparoscopic surgery, similar to GERD Only patients. In addition, patients with Both as well as patients with GERD Only were more likely to be readmitted than patients with no disease. The results of the sensitivity analysis showed that patients with GERD and another esophageal diagnosis were comparable to patients with only GERD, and thus, should be considered as GERD patients.

Obesity and GERD are correlated (1), and in our sample patients with GERD were more likely to be obese. Our sensitivity analysis, not unexpectedly, showed that obesity was an independent factor related to all-cause morbidity when bariatric surgery patients were excluded. We evaluated whether obesity was the driving factor leading the association between GERD and complication rate by adding obesity as a covariable; it did not impact the association between GERD and morbidity. In addition, even excluding obese patients and bariatric surgery patients, the association between GERD and morbidity approached significance. As most patients with GERD were undergoing bariatric surgery, we believe that lower sample sizes drove this association slightly below significance, and thus believe that the association between GERD and morbidity exists independent of obesity.

The targeted procedure group most likely to contain patients with GERD was bariatric surgery. This perhaps explains why bariatric surgery is the only procedure type in which the effects of GERD have been described in the current literature (7–9, 21). Three of these studies found that preoperative GERD was associated with increased postoperative complication risk, including reoperation (7–8), readmission (9), and overall and gastrointestinal complications (7). Only one study found no significant impact of GERD on the postoperative complication of marginal ulceration after laparoscopic Roux-en-Y bypass (21). The current study expands the scope of investigation from bariatric surgery to all surgery taking an abdominal approach, and combining two major databases over ten years representing one of the largest cohorts to assess the impact of GERD on surgical outcomes.

Several studies have explored the increased risk of postoperative complications, including reoperation (10) and postoperative emesis and food intolerance (11–12) in bariatric surgery caused by preoperative esophageal dysmotility. Current literature exploring the impact of preoperative esophageal diseases other than GERD includes studies concluding lack of impact of preoperative esophagitis on the effectiveness of anti-reflux surgery (22–23) or of

the lack of association between preoperative esophageal dysmotility and outcomes following fundoplication (24–26). Our study is the only study to explore the impact of preoperative esophageal diseases such as achalasia, stricture, ulcer, Barrett's, and diverticulum on postoperative complication rates. The low prevalence of other esophageal disease compared to GERD may explain both a lack of significance in our findings as well as a paucity of literature exploring the impact of non-GERD esophageal disease on surgical morbidity.

Our study is the only study to date to find that wound and renal postoperative complication rates are increased in patients with GERD. A greater rate of renal complications may be explained by concurrent PPI use, which has been linked with both acute (18) and chronic (19) kidney disease. The association between wound complications and GERD may be related to the association between acid suppression and bacterial overgrowth (27) as well as increased clinical infection rate (28); however, most data on this topic relates to enteric infection and bacterial growth. Long-term PPI use has also been linked to B12 deficiency in elderly patients, which may contribute to poor wound healing (29–30) and thus, wound complications in elderly surgical patients. Over time, GERD can lead to erosive mucosal injury of the upper GI tract, which may lead to increased permeability. Increased intestinal permeability is correlated with increased infection rates in burn patients (31); it is possible that a similar mechanism exists in GERD patients. Another possibility is that GERD, by causing a pro-inflammatory baseline state, exacerbates the post-surgical inflammatory state resulting in impaired wound healing (32). It is outside the scope of our paper to assess the mediating effect of anti-reflux medication or surgery in our patient cohort. Additional research is needed to explore this and also to determine whether other esophageal disease has a significant impact on postoperative complications, or whether preoperative testing such as manometry and pH testing and other modifiable behavior or medical changes could positively impact pre- and intra-operative management of these patients.

Limitations

This study has several important limitations. The retrospective nature of the analysis limits the ability for randomization and increases potential for confounding. Although both cardiac (16–17) and respiratory (13–15) pathologies have been linked to GERD, we did not find a significant association between GERD and these complications. This was likely impacted by limited power and the low rate of these complication subtypes in our patient population. The diagnoses of GERD and other esophageal diseases were claims-based attributions using ICD-9 codes. We attempted to mitigate diagnostic inaccuracy by not using medication as confirmation of diagnosis. Additionally, patients with temporary reflux symptoms may have a proton pump inhibitor listed in their medical record, as it is a common over-the-counter medication. As mentioned, this also limits our conclusions as the effect of anti-reflux medication or surgery on our outcomes of interest was not assessed nor the association between complication rates and patients with GERD treated or not treated with a PPI evaluated. Including results of upper endoscopy, pH monitoring, or esophageal manometry to confirm diagnosis of GERD may have improved accuracy. However, this is not routinely performed in practice.

Conclusions

The current study is the first to demonstrate that preoperative GERD is associated with increased postoperative complication rate, including overall, renal and wound complications, and 30-day readmissions for intra-abdominal surgical patients, and to explore the impact of other preoperative esophageal disease on these rates. We recommend more research to explore the strength and nature of this connection, particularly what mechanisms there might be that explain the elevated risk associated with GERD, and whether the association is affected by concurrent PPI use or anti-reflux surgery. For the surgical patient specifically, measures such as extubation protocol changes, preoperative disease assessment, PPI initiation or discontinuation, and different aspiration precautions all may be considered if the nature of this association is further elucidated.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

GERD	Gastro-esophageal reflux disease
ACS-NSQIP	American College of Surgeons National Surgical Quality Improvement Program
CDR	institutional Clinical Data Repository

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Figure 1:

Overall all-cause 30-day complication risk of targeted procedure groups across all esophageal disease statuses with pancreatotomy as the comparator as an OR of 1. Complication risks varied significantly among targeted procedure groups (multivariate model, error bars with 95% CIs). P-values were corrected for multiple comparisons using Bonferroni method.

Figure 2:

Odds ratios of primary and secondary outcomes for patients with GERD and other esophageal disease. A: Patients with GERD had increased risk for overall complications as well as wound and renal complications and readmission. P values with *** were less than 0.05. B: Other esophageal disease did not significantly impact complication or readmission risk.

Table 1:

Demographic characteristics of patients undergoing intra-abdominal procedures, split by esophageal disease status.

Demographic	No Esophageal Disease	GERD	Other Esophageal Disease	p value
Age, mean (SD), y	53.36 (16.32)	54.67 (14.31)	59.62 (13.38)	< 0.001
Sex, # (%)				< 0.001
male	3,156 (43.71)	601 (33.38)	78 (50.65)	
female	4,064 (56.29)	1,199 (66.62)	76 (49.35)	
Race/ethnicity, # (%)				< 0.001
African American	888 (12.3)	281 (15.61)	23 (14.94)	
Caucasian	5,986 (82.9)	1,483 (82.39)	126 (81.82)	
Hispanic	162 (2.24)	13 (0.72)	1 (0.65)	
Other	185 (2.56)	23 (1.28)	4 (2.6)	
BMI, mean (SD)	32.2 (10.9)	36.5 (12.0)	29.9 (9.0)	< 0.001
NSQIP Morbidity Risk, mean (SD)	0.15 (0.14)	0.14 (0.13)	0.18 (0.13)	< 0.001
Laparoscopic procedure (%)	2,737 (37.9)	872 (48.44)	46 (29.87)	< 0.001

Table 2:

Prevalence of esophageal disease in targeted procedure groups.

Targeted Procedure Groups, # (%)	All Intra-Abdominal Procedures	No Esophageal Disease	GERD	Other Esophageal Disease
Pancreatectomy	845 (9.21)	708 (9.8)	103 (5.72)	34 (22.08)
Colectomy	2,069 (22.55)	1,707 (23.64)	320 (17.78)	42 (27.27)
Proctectomy	484 (5.28)	408 (5.65)	70 (3.89)	6 (3.90)
Ventral Hernia Repair	1,537 (16.75)	1,050 (14.54)	457 (25.39)	30 (19.48)
Bariatric Surgery	1,841 (20.07)	1,211 (16.77)	612 (34)	18 (11.69)
Hepatectomy	600 (6.54)	541 (7.49)	58 (3.22)	1 (0.65)
Appendectomy	756 (8.24)	675 (9.35)	71 (3.94)	10 (6.49)
Abdominal Aortic Aneurysm Repair	271 (2.95)	243 (3.37)	27 (1.5)	1 (0.65)
Open Aortoiliac Repair	226 (2.46)	178 (2.47)	42 (2.33)	6 (3.90)
Hysterectomy, Myomectomy, Oophorectomy	546 (5.95)	500 (6.92)	40 (2.22)	6 (3.90)